TWO LECTURES

ON

THE STUDY

OF

ANATOMY AND PHYSIOLOGY,

DELIVERED AT THE

OPENING OF THE MEDICAL SESSION, 1830,

IN THE

MEDICAL SCHOOL, ALDERSGATE STREET.

BY

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LECTURER ON ANATOMY AND PHYSIOLOGY.

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TO

THE STUDENTS

IN

THE MEDICAL SCHOOL,

ALDERSGATE STREET,

THESE PAGES ARE INSCRIBED

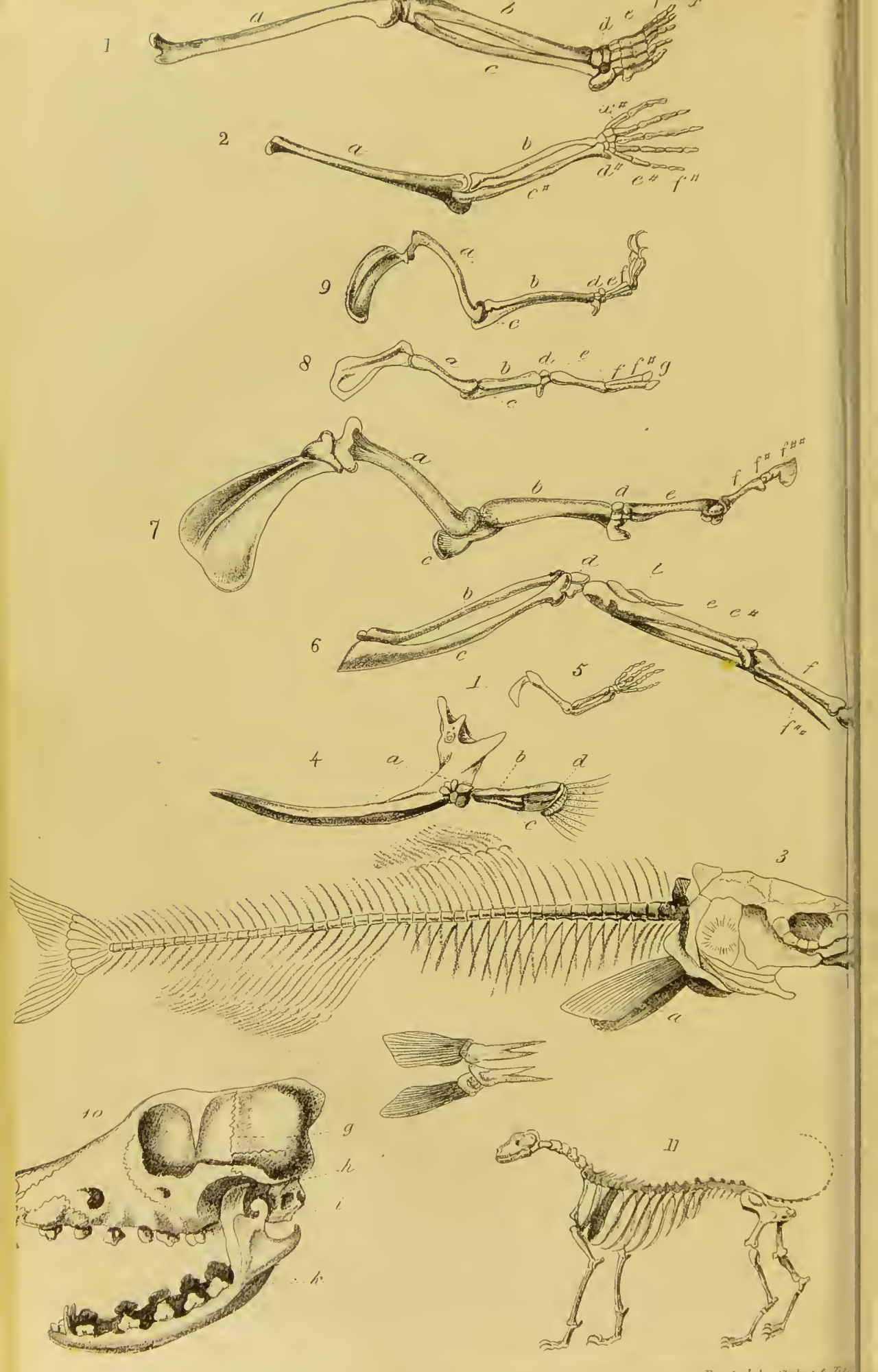
BY

THEIR SINCERE FRIEND,

THE AUTHOR.

ERRATA.

Page
10, in notes, for fig. 8, 10, read 7, 8.
22, last line, for *complete*, read *complex*.
24, line 13, for *have to come*, read *have come*.
28, line 6 from bottom, for *centre of the circumference*, read *centre to the circumference*.
32, line 3 from bottom, for *on those*, read *in those*.
34, line 24, for *confessed a permanently*, read *confessedly a permanent*.
39, line 20, for *of vessels*, read *of the vessels*.
44, line 17, for *observations*, read *aberrations*.



Drawn from Nature by J Shield on Stone by C Burton

Printed by Stokes & Till

LECTURE

ON THE

STUDY OF ANATOMY.

FEW things in this life, Gentlemen, are more pleasing, than to meet, after an interval of separation, those whom we esteem as friends. If there be any thing that can awaken a kindred feeling, it is that of resuming one's pursuits, particularly if they be favorite pursuits, after they have been discontinued, from accident or illness. It is my lot to experience both these feelings at our first meeting here. To meet you any where would always be to me a pleasure, but more particularly in this place, for it was here my first essays in public instruction were made, and here I received many proofs of kindness and consideration from you, as well as from my respected friends and colleagues in office. Whilst here, it was always my practice to join my young friends in their studies,—to guide their pursuits, and shorten their labour, by giving them the results of whatever knowledge I possessed,—of whatever experience I had acquired. These pursuits are now resumed, to be continued from day to day, and to be unremittingly directed to whatever can facilitate your studies, lighten your labour, or promote your interests.

I need scarcely remind you, that the Medical Session in this, as well as in other Institutions, is generally ushered in by one or two introductory discourses, which serve the purpose either of explaining the plan and arrangement of the lectures about to be delivered, of exhibiting a general view of the subjects of which they treat, or of inculcating some useful general principles. Usage lends its sanction to this practice, and experience justifies its continuance; for, were we to enter abruptly on the business of our Course,—were we to plunge at once "*in medias res*," before we proceeded far we should discover

that we were treating of details, omitting principles, and accumulating facts without order or method.

Few pursuits comprise a greater variety of details than Anatomy; none can exhibit a greater number of facts, all bearing more or less directly on the duties of an arduous profession; and, if its study be not conducted with method, if at each step of your progress you do not see the object for which these facts are collected, and learn the applications which should be made of them, your minds would soon become oppressed by a load of detail, and would be repelled from the pursuit by its complexity, instead of feeling an interest awakened by the nature of the inquiries which it every moment suggests.

Medicine, in reference to which Anatomy is generally cultivated, has been justly termed "a science of observation;" and Anatomy has, not unaptly, been named "a science of facts,"—facts with which we seek to become acquainted, not merely because they serve to explain the structure of the human body, or because they lead us to a knowledge of the uses of its different parts, but because of the light which they shed on the seat, the nature and causes of disease,—a light, without which, Medicine would be little else than a blind empiricism.

The views and purposes for which a particular pursuit is studied, and the motives and arguments that may be adduced to incite others to its cultivation, must necessarily be as various as are the degrees of information possessed by different individuals, the extent of their acquirements, or the quantity of their acquaintance with the subject. Thus, one person studies Anatomy as a branch of natural science, another, for the light which it throws on the seat and nature of diseases, whilst a third descends as low as a reasoning being can descend in his estimate of a subject of serious concernment, when he avows that he studies it because it is one of the legal requisites for the practice of Medicine. This motive is not confined to a few; its influence, I fear, extends to many, manifesting its effects on the tenor of their studies in early life, and subsequently on their professional character and prospects. When an opinion has once sprung up that the main object of a man's ambition is attained when he is fitted to pass through a particular ordeal, many individuals will be disposed to rest

satisfied with such a modicum of information as may suffice for that purpose, and to content themselves with having gone through the routine duties which certain forms and regulations prescribe: but if the qualifications hitherto required by these regulations were examined, it would be found that they were fixed at the lowest degree which any thing like professional attainment could admit of, and that they could not, by any means, be deemed adequate to enable a man to discharge the duties of his profession with credit to himself, or satisfaction to others. In these particulars, however, some beneficial changes have of late years been effected, by those to whom is confided the direction of medical education. The period of study has been enlarged, the list of qualifications extended, and other steps have been taken to keep pace with the progress of that improvement which is confessedly making way amongst the community at large, as well as amongst our professional brethren.

When we look around us at the present conjuncture, and survey the busy scene that opens to our view; when we observe the ceaseless activity which pervades every class and denomination of persons, and catch the spirit which animates them;—when we observe the greedy avidity they evince in the pursuit, not of novelty merely, but of knowledge;—when we see, not only the efforts that are made, but the combinations that are formed for the diffusion of information amongst all classes and conditions of men;—when it is proclaimed aloud, and from the high places too, that the cultivation and improvement of man's intellectual and moral character should be promoted by every possible means, and without any reservation with regard to grade or condition, to wealth or station;—when this principle is not only announced, but acted on, and reduced to practice, not merely in one place or in two, and as it were for an experiment, but in every district and province of the kingdom; — when we observe all this, we cannot fail to recognize at a glance the spirit which characterizes the age in which we live, and distinguishes it from any other that could be named in the eventful history of our country. In the midst of this stirring scene, witnessing at every step of our progress the effects of this singular combination of efforts to achieve the noblest purpose at which a community can aim—its own social and

moral regeneration, it would be a singular anomaly if the members of a profession (usually designated as liberal and learned,) were alone to remain inactive. Connected as we are with every grade and condition of men, observing their pursuits, noting their opinions and the impulses which guide them, we cannot fail to be influenced by any decided impressions that are made upon them; and, whenever the tide of improvement or of change sets strongly in any particular direction, we cannot avoid being borne on with the current. At the present day, when the different ranks and classes of the community are combining to carry on the work of improvement, by forming institutions for the diffusion of knowledge, by collecting libraries and establishing lectures,—as members of the great social family we necessarily take part in these undertakings; but does the same spirit animate us as members of a learned profession? If it does not, the rank and station hitherto conceded to professional men, in consequence of the education they have received, and of the superior knowledge they were supposed to possess, will be denied to us. If we alone remain stationary, whilst all around us is in a state of progressive improvement;—if we alone remain fixed to one point in the intellectual scale, whilst the rest of the community is ascending, we will serve at least one purpose, though that is not a very creditable one, that of enabling the attentive observer, by comparing our apathy with the activity of others, to measure how far the tide of improvement has flowed on. But this, I am sure, can never take place: if no better motive impels us, the spirit of rivalry cannot fail to act as an incentive, and that incentive is now applied from a quarter which we could never have anticipated.

I have just alluded to the efforts and combinations that are now at work for the attainment of a great national purpose. As if to aid and direct these efforts on the part of the community, an Association has been formed, within a few years, consisting, for the most part, of men distinguished not only by the rank which they fill in society, but also by their talents, acquirement, and public spirit. This Association has been formed, not as other literary unions are, for the extension of information amongst their respective members, or for the cultivation of some particular department of

science, but for the universal diffusion of knowledge amongst all classes and orders of men, from the highest to the lowest. The plan adopted for this purpose seems well calculated to attain the end proposed. It consists, for the most part, in publishing in separate parts, from week to week, small treatises on different departments of useful knowledge, sketches of history and biography, together with condensed views of the most instructive portions of Natural Science. These are written in such a way, as to convey clear ideas of the subjects of which they treat; but their chief effect must be to infuse a spirit for further inquiry, and create a taste for scientific pursuits. Amongst these little works we find some which bear immediate reference to our present purpose. Here are two which treat of Anatomy: their object is to convey to the general reader an idea of the various mechanical contrivances which are found in the structure of the human body,—to point out the provisions devised for its security, and the evidences of design and of forethought traceable in different parts of its conformation. They are headed,' 'ANIMAL MECHANICS." In the perusal of them you will at once observe the workings of an acute and discerning mind, and perhaps recognize some of the peculiar views of a celebrated Anatomist to whom they are generally attributed. The others are entitled, "ANIMAL PHYSIOLOGY;" they are four in number, and have been written by a learned and accomplished Physician. They are marked throughout by clearness and precision of style, and an intimate acquaintance with the subject.

When productions such as these circulate widely amongst the community,—when men of all classes become acquainted with the subjects of which they treat, does it not behove you, who, in the discharge of your professional duties, must necessarily come into contact with persons thus instructed in what hitherto was considered as your own special province, to be able to show them not merely that you are not ignorant of them, but that you are intimately acquainted with them? The rank which is conceded to you in society is not supported by prescription or by privilege, it depends on public opinion, and can be sustained only by acquirement and knowledge; if, on examination, you be found deficient in these, no matter to

what adventitious aids you may trust—no matter to what expedients you may resort,—nothing can sustain you, in your present position, you must fall to a lower level, and sink in public estimation.

You will naturally be prompted to enquire whether there is any thing in the study of Anatomy sufficiently attractive to awaken the attention or stimulate the curiosity of inquiring minds; you will find much at almost every step of your progress. The practical applications of Anatomy, its subserviency to Medicine and Surgery, are not now denied or questioned. I need not, therefore, on the present occasion, dwell on them; they will come before us from day to day. I shall call your attention to some general results and views of the subject, calculated to show you what Anatomy is when treated as a science. Let us set out with something plain, or even common-place; then, taking it as a point of departure, pass on to subjects a little more comprehensive, or even recondite.

Suppose, then, we take one of the most obvious parts of the body, viz. the upper Extremity. Observation shows us how well adapted it is for its different purposes and uses, and how infinitely various these are. Let us contrast it with the lower extremity: placing them side by side, we see that the parts of which they are composed, I mean the anatomical elements of which they are made up, are analogous in every particular. Just take the basis, or substratum, which gives support to the other structures,—the osseous part: laying them thus together, (fig. 1, 2,) we see that they consist of the same number of pieces, viz. the Femur (*a*), and Humerus (*a**), the two bones (*c*, *d*,) of the Leg, and those of the Fore-arm (*c** *d**), seven in the Tarsus (*e*) and Carpus (*e**), five in the Meta-tarsal row (*f*), and that of the Meta-carpus (*f**), and lastly those of the Toes (*g*), and of the Fingers (*g**). The Femur, strongly made, is, at its upper part, lodged in a deep cup-shaped socket, by means of which the whole weight of the body is thrown on the limb; at its lower end it is expanded so as to increase the surface by which it rests on the leg. The bones of the Leg are also firm in themselves, and closely bound together so as to admit of no motion upon one another; they rest securely on the foot, the upper bone of which is lodged in a socket, which they form. The Humerus, on the contrary, is barely in contact with a super-

ficial depression on which it moves, and so admits, at the shoulder, the utmost variety and latitude of movement; the bones of the Fore-arm too are calculated for flexibility and motion, one rolling on the other, and both fitted with a perfect apparatus of muscles or moving powers, which, with the utmost ease and precision, turn the Wrist, and guide the Hand to any object to which it is to be applied. The bones, then, in arrangement and general plan, are similar, yet, by slight modifications, are fitted for totally different purposes.

The Hand and the Foot [2, 1,] agree in the elements of which they are composed, and in the number of them; but they are developed so differently in each, that they form totally distinct Members, and serve for widely different purposes. The solid and the moveable parts in each are strongly contrasted; the pieces which compose the solid part of the Foot [fig. 1 *d*] are strong and large, those of the Hand [2 *d**] are comparatively diminutive, but the Fingers, or flexible part [*f**], are largely developed, as compared with the Toes [1 *f*]. It is commonly said that this arises merely because the Toes are less necessary for support and progression than the rest of the Foot, whilst the Fingers are more necessary for prehension and adjustment than the rest of the Hand; it would be more correct to say that it is the result of a general law which pervades the whole Animal Kingdom,—a law which establishes what may be termed a principle of compensation, by virtue of which, if any given part is increased above par, its increase is effected at the expense of some other; or, as it has been technically expressed, if the "formative effort" be strongly directed to one part, it will be less so to some neighbouring one. The arch of the foot is the more important part in reference to its general purpose of sustaining the body, the Toes being obviously less so as a means of support or progression. It is just the reverse in the Hand: the Fingers, or flexible part, being the more important one, in reference to the various purposes which the Hand has to perform, and therefore they are proportionally evolved or developed.

Again, when we direct our attention to a single part of the Hand, viz. the Thumb [2 *x*], and contrast it with the corresponding part of the Foot [1 *x*], we see how a new instrument is produced by a mere

modification of its constituents. The bones, the muscles, vessels, and nerves, of the Thumb, and of the great Toe, are respectively analogous, yet how different are the purposes which they are intended to fulfil? The first bone of the Toe is thick and strong, it ranges with those of the other toes, and admits of little more motion than they do, as it is one of the chief points on which the weight of the body is thrown in its different movements. The first bone of the Thumb admits of every variety of motion; it does not range with those of the Fingers, from which arises its most striking peculiarity, that of being brought into opposition with the rest. In its various uses, it is not merely a part of the Hand,—it is rather a new member, or a supplemental hand. Thus we see what a variety of results are obtained from a few materials, and how, by a modification in the form, proportion, and arrangement of the same constituents, new Instruments are produced,—new Powers created.

But let us not confine our attention to the structure of the human frame, let us glance at that of animals, still, for illustration, confining our attention to the instance already selected, viz. the upper or anterior Extremity; take that in one of the lower animals, say the Cat; ordinarily it sustains the body, therefore, is an instrument of support; its parts move on one another, and, when acted on by the muscles, it becomes an instrument of progression; it is terminated by moveable phalanges, which may be flexed or extended, and so it becomes a means of prehension; finally, the last phalanges, which are usually turned back, may be pushed forward to a line with the rest, protruding the sharp nails with which they are armed, and so it becomes an instrument of attack or defence. In the Monkey this limb serves for support, and progression, but chiefly for the prehension of objects; it is not well calculated for defence or attack. In the Dog and in hoofed Animals it serves for support and progress; in Birds for progression only; whilst in Fishes it merely assists in progression, as that is effected chiefly by the movement of the hinder part of the body. Now, in the anterior limb in all these animals, we find the same bones, muscles, nerves, vessels, &c.; and all the variety of purpose which they serve is attained by modifications in the size, form, and mode of connexion of these components. We often speak

of the simplicity of Nature's works,—here that simplicity is fully exemplified. These limbs consist of the same parts, their materials are identical; yet, as we have seen, they execute different functions, and so may be considered as different organs, which is sufficiently indicated by the different names by which they are popularly known. And all this is effected by one portion being largely developed, a contiguous one being less so,—some being evolved to a maximum, whilst others are left rudimentary, as if nature were sparing of her materials, yet profuse in the results she would elaborate out of them :—And this is what we really mean when we speak of the simplicity of Nature's works, as contrasted with the grandeur and comprehensiveness of her designs.

I would fain carry your attention with me yet a little farther, for the purpose of giving you a *coup d'œil* view of the structure of Man and Animals. When we have surveyed and inspected attentively the different divisions of the Animal Kingdom, and examined the structure of its different Orders, say from the Fishes up to the Mammiferæ, we see that, though variously modified, the proximate or anatomical constituents of the members (as in the instances cited,) and also of the trunk, are analogous. Now, whilst we pass from link to link in this great chain, if the mind dwells sufficiently long on each of the Natural Families which it connects, to retain an impression of its fundamental form, omitting the minor traits which give to each its individuality; if, in a word, as it passes from the lowest to the highest, it retains that which is essential in the form and composition of each, abstracting its peculiarities, it will gradually ascend to the contemplation of a form, which will be a Type or Representative of all, divested of the peculiarities which mark each of them. Having thus ascended to the contemplation of a Type, or abstract Form, which may be conceived to contain within it the components, or anatomical elements, of each of the Natural Families, (Fishes, Reptiles, Birds, Mammalia,) but yet stripped of the peculiarities of figure which characterize them respectively ;—having arrived at such a form, I say, and retained it for a while before the mind's eye, so as to fix the impression of it, we may readily reverse this mental process, and proceed to evolve the Model which is thus present to the mind,

and give to each limb, as well as to the body, such a degree of expansion or development as will make it represent a Fish, a Reptile, a Bird, or a Quadruped. Thus, for example, leaving the anterior Extremity in its rudimental state, we leave it at the bottom of the scale in form of the Fish's fin. [In 4, *a* represents the bones of the Shoulder; *e, f,* the Radius and Ulna; *d,* the fin-rays, being so many digital processes.] We find the osseous structure very perfect in the limbs of the Amphibiæ: [fig. 5 represents the arm of the land Tortoise.] Passing over the Reptiles, where it still remains unevolved, it must be developed considerably to form the wing in the Bird tribe;† [fig. 6 shows part of the wing of a Bird; *f,* the Radius, *g,* Ulna; *h,* Carpus; *i,* the Thumb; *k,* Meta-carpal Bone of the great Finger; *l,* same Bone of the little Finger; *m,* the great Finger, with its two Phalanges; *n,* the little Finger.] And the parts, by receiving their appropriate adjustment, will be made to represent the foot of the Dog, that of the Horse, and finally the hand of Man. Having thus completed and sketched out a part in each, we may, by a similar process, complete the figure by following it out through the posterior Extremity, and then the body, spine, and head; the parts of the skull being analogous to vertebræ. It is in this way only that we can form any adequate idea or conception of the plan or groundwork from which the different varieties of animal forms are deduced. For, when we look over a menagerie, or a great assemblage of animals, our first impression is that of variety and discrepancy, but, on a closer inspection, we find that some are nearly allied, and form groups or families, marked by certain peculiarities and natural affinities. But we could never have supposed that any uniformity of plan ran through them all, unless we had examined

† Fig. 9 is right Fore-leg of a Dog; *a,* Humerus; *b,* Radius; *c,* Ulna; *d,* Carpus; *e,* Meta-carpus; *f, g, h,* Phalanges.

Fig. 8 is part of the Fore-leg of a Horse; *d,* Carpus; *e,* the great Meta-carpal, or Cannon Bone; E*9*, Rudiment of the second Meta-carpal Bone; *f,* first Phalanx, or Fetlock; *g,* the second (Coronet); *h,* the third, or Coffin Bone.

Fig. 10. The anterior Extremity in the Goat, the letters of reference indicate the correspondence of its parts with those of other animals above it and below it in the animal series.

their intimate structure and composition. Then it is that we readily see the analogies by which they are associated, and trace the unity of design which runs through the whole scheme.

Your attention has doubtless been, at some time or other, directed to a consideration of what is termed the "ideal form" in the Human figure. It was at one time supposed, that in order to get an idea of such a form, so as to be able to picture to his own mind that outline, which he first modelled and then sculptured into this statue—the Venus de Medicis, or rather the original from which it was taken, the Artist was obliged to select the detached beauties observed in different individual figures, and then combine them, so as to form out of them a well proportioned whole. Were such a process followed, there could be neither unity nor symmetry in the result; it would certainly be an incongruous jumble of parts, without proportion or harmony. The process which is really adopted, is as nearly as may be the reverse of this. It is not by combining the detached excellencies of individual forms that the desired result is obtained; it is by passing in review a great number of individual instances, omitting the peculiarities distinctive of each, but at the same time retaining the substratum in which these peculiarities adhere. The outline, or model, obtained by this mental process, is an abstract representation of the race; or, at all events, of the individuals inspected, but it is divested of all those slighter traits on which their individuality depends: hence it is called, the abstract or ideal form, the "beau ideal." We may extend the application of this process: we may note the intellectual qualities which distinguish individuals, omitting the peculiarities or defects of each, but retaining the substratum of good traceable in all, and so ascend to the contemplation of a mind, a spirit, an intellect, fitted to give life and animation to such a form. Thus, in different departments of science a defined end is sought, and the same mental process is adopted in each, — it succeeds in all, which is adequate evidence of its correctness and sufficiency: the Zoologist seeks to form a conception of the model from which the different varieties of animal forms are deduced:—the Artist endeavours to picture to himself the outline of a form which may serve as a representation of the race, and which, as such, must be divested of all the peculiarities on which individuality

depends: and the Moralist seeks to conceive an intellect fitted to animate such a form; each, without concert with the others, adopts the same mental process, viz. Abstraction, and all attain the desired result.

These views are not of a merely speculative character; if they were I would not present them to you in this place; they are the views, (I mean so far as relates to the unity of Organic Elements,) which appear to have been present to the mind of Cuvier whilst he was engaged in his inquiries into the Fossil Remains of animals which have been discovered in different places. It was by acting on such views that this eminent Naturalist was enabled to determine the genus and species of an animal by possessing only a few fragments or pieces of its skeleton, and thence to assign its conformation, natural habits, and abode, with almost as much precision as if it were living, and could be made the subject of actual observation.

You will doubtless ask, what is the train of inference which leads to such results? I shall state it as nearly as I can remember in Cuvier's own words, as given in the prefatory discourse to his great work on Fossil Remains. When we carefully examine the forms and structure of the different natural families of animals, and of their several subdivisions, we trace such a correspondence between the parts of those nearly allied, and such a dissimilarity between these and all others, that we can rigorously determine any of them by almost any fragment of it.

For, in point of fact, we find that every organized individual forms an entire system of its own: all its parts mutually correspond, and concur to produce a certain definite purpose by reciprocal reaction, or by combining to the same end. Hence it is that none of these parts can change its form without inducing a corresponding change in the other parts of the same animal, so that each part taken singly indicates all the rest to which it belonged. If the viscera of an animal are so formed as to fit it for digesting raw animal food, the jaws will be found so constructed as to fit them for devouring their prey, the claws for seizing and tearing, the teeth for cutting and dividing, the limbs for pursuing and taking, the organs of sense for seeing at a distance, and the brain is endowed with instincts for concealing and lying in wait.

These are the obvious characteristics of Carnivorous animals; they are the very conditions of their existence, and point at once to an appropriate internal structure and conformation. Thus, in order that the jaw should be well adapted for the prehension of objects, its condyle must have a peculiar form, the temporal muscle a certain size, the hollow in which it is lodged a certain depth, the zigoma a certain degree of convexity to allow it to pass beneath, and also a certain degree of strength to sustain the action of the masseter muscle: in other words, the moving power, the fulcrum, and the resistance, must be adjusted and proportioned. [fig. 10 *g. h. i.*]

Again: the teeth, to be able to tear and cut, must be sharp, and of a certain form, their roots solid and strong, to gnaw bones; hence they determine the form and development of the jaw bone into which they are inserted. The paws are subsidiary to the jaws and teeth; they are formed for strength and mobility; and, consequently, present in their bony structure a determinate form, as well as a corresponding adjustment in their tendons and muscles. For instance, the fore-arm must move freely in different directions, and therefore requires a determinate form in its bones. The bones of the fore-arm articulate with the humerus, so that any change in the one must influence the form of the other. The scapula too assumes a particular form, as it must be strong to give a firm support to the limb in such animals, and their muscles acquire a development corresponding with that of the bones which they have to move and act on. [fig. 9 *a. b. c. d. e. f.*]

"A similar adaptation of structure and arrangement must obtain in the posterior limbs as well as in the spine and trunk; the bones of the nose are developed largely, so are the orbits and ears, corresponding with the perfection of the senses in such animals. We see, then, that the structure of the teeth regulates the form of the claw, the humerus, and the scapula, so that either of these enables us to determine the teeth, and reciprocally the teeth indicate the others just as the equation of a curve regulates all its other properties: and as in regard to any particular curve, all its properties may be ascertained by assuming each separate property as the foundation of a particular equation, in the same way a claw, a scapula, a leg, or an arm bone, enables us to

determine the description of the teeth to which they belonged, and reciprocally we can determine the other bones by the teeth.

It may be said, that though we may from such data infer the class or natural family to which an animal belonged, we could not fix with any precision its genus or species; we can, however, ascertain both, by going a little more minutely into its structure. Confining our attention still to the instance already cited, the Carnivorous animals, we find that each species has special aptitudes to fit it for the peculiar sort of animals on which it is to support itself, so that its minute conformation will vary according to the size, habits, and haunts of its prey. We can therefore trace in every part of it a general plan or outline which determines its class and order, and next, a number of minute modifications which fix the genus, and even the species. Thus a person who is well acquainted with the laws of organization, by commencing with a single bone, may sketch out or re-construct the whole animal to which it belonged." Such were the principles which Cuvier brought to bear on the various questions which arose out of the examination of the Fossil remains of animals, and by which he was enabled to class and arrange them with as much precision as if he had their entire skeletons before him, and from which he has deduced so many important inferences with regard to the changes which the earth's surface has undergone during its different revolutions.

We have in this way presented to our view a subject which comprises a variety of details sufficient for the most scrutinizing enquirer; and, at the same time, sufficiently extended to engross the powers of a mind the most comprehensive. The Anatomist sees before him a number of subjects inviting the most minute research; the Physiologist observes a series of adaptations of means to end, of structure to function, which point at every step of his progress to evidences of forethought and of knowledge; the Zoologist traces the unity of design which pervades the whole scheme of animated nature, from which he cannot fail to infer a unity alike in the design and the Designer, whose attributes, as traceable in all his works, are wisdom and power, with the adjunct of infinity in each. This is the conclu-

sion to which the study of Anatomy and Zoology, if fairly conducted, will always lead: it was to indicate this result that I called your attention to this subject, and also to shew you that the study of the structure of animals did not consist in dry details or useless minutiæ; and, moreover, that the appearance, of complexity and difficulty, which it presents at a first view, ceases, or is greatly diminished, by having a clue to guide your steps and direct the course of your enquiries; and in proportion as complexity and difficulty are removed from the pursuit, will a taste and a liking for it spring up. Until very lately, the study of Zoology and comparative anatomy was greatly neglected by our professional brethren: they appear to have regarded it as something fitted to employ light minds, or occupy hours of leisure and amusement. A slight examination, however, would suffice to shew, that the facts it unfolds are not merely interesting,—that they are instructive in the highest degree, as they tend to throw considerable light on several obscure points connected with the anatomy of the human body, by affording the means of comparing the composition, arrangement, and properties of its different organs, with the corresponding parts in other animals. Whatever removes obscurity or doubt enlarges the boundaries of knowledge, and lessens the dominion of error and ignorance; so whatever increases our knowledge of the structure of the human body, necessarily elucidates its functions, and throws a light on those derangements of structure and function which constitute disease.

I now direct your attention to another topic not less attractive or interesting,—I mean those organs by which we maintain our relations with the world around us. By the Taste and Touch we learn some of the ordinary properties of different substances; by the Ear we recognize all the shades and varieties of change impressed by sounding bodies on the atmosphere, and appreciate their characters by means of the impressions which are conveyed to the sentient extremities of the nerves. The Eye makes us acquainted with other properties of bodies, more particularly their colour, which, but for its assistance, would remain for ever unknown to us; but it is not merely of the existence or of the properties of things in our immediate vicinity that we are apprised by this wondrous inlet to knowledge, its field of view extends

far beyond the narrow sphere in which we move and live: at a glance it darts through the immensity of space, and reveals to us the harmony and order which reign through every part of the system. It has been often and truly said, "that as we take no note of time but from its loss," so we seldom set a true value on our powers and possessions until we have felt their privation; how limited would not our knowledge, and our capacity of enjoyment be, but for the organ of vision! but for that of hearing, would we not be incapable of receiving communications from those around us? would we not be reduced to the state of mutes, incapable of giving expression to our thoughts, and utterly unfitted for the social condition. You examine the Ear, you are told it is an acoustic apparatus; you study the Eye, it is called an optical instrument, yet you find it greatly more perfect than any instrument of human invention or contrivance: a knowledge of its structure is indispensably necessary to a right understanding of the many questions that arise out of inquiries into its functions; and, when you consider the delicacy and minuteness of its parts, and the diseases to which they are liable, and then reflect on the operations required for their cure, you will at once perceive how carefully you must study the structure of this organ, if you ever intend to practise ophthalmic surgery.

By these various means, and by the aid of these different instruments, man is placed in close and constant relation with the world around him: his wants are supplied, and his enjoyments ministered to from the earth on which he lives, and the more we examine his conformation, the more convinced do we feel of its adaptation to all the complexity of relation and purpose which grows out of his peculiar position. He thinks, he feels, he reasons too; and, accordingly, we find him endowed with a special organ, the Brain, which has been termed "the material instrument of the mind." This we recognize as the controller,—the director of the different parts of our complex system; to it they are subservient, by it they are guided in their various ministries. What subject can be better fitted to engage your attention than the structure and function of this organ? But, confessedly, there is not one within the wide range of the Psychology of man, that is more beset with difficulty, or which involves more doubtful and

litigated questions. Judging from what we feel in ourselves, or what we know of our personal identity, we should perhaps consider the brain as a unit or single organ, which ministers to the general purposes of innervation; I use that term in an extended meaning, as including, within its comprehension, all those properties and endowments, whatever they be, which flow from, and are dependent on, nervous influence. But were we to look at it in another point of view, were we to trace its varieties of conformation in the animal series, and, at the same time, note the steps of its development in man from the first moment of conception to its full evolution, we perhaps would be disposed to consider it, not as a unit or single organ, but as an aggregate of units or single organs, each ministering to a distinct function, and all conspiring to a common end,—the innervation of the subject.

These different parts, then, of the animal economy, present, as a subject for investigation, sufficient inducements to engage the attention of inquiring minds; but it is not as a matter of inquiry, or of curiosity, that you engage in such pursuits, it is with a view to make practical applications of the knowledge you acquire, when you enter on the duties of your profession. In this point of view, the study of the structure and functions of the human body becomes the pivot on which all your pursuits turn, and to which all your inquiries must have a reference. The sphere of your usefulness is wide and extended, it embraces all the physical ills "which flesh is heir to:" every form of the infinite malady is included within your province, and submitted to your direction; and no matter whether any particular case that is presented to you, be slight in its degree, or short in its duration; no matter whether it be a fancied ill or a real disease, the one is not the less real to the mind and feeling of the sufferer, or the other a less serious disturbance of his health and his comfort; all equally demand your care and attention, without any distinction as to their cause, their duration, or degree. To acquire the knowledge necessary to discharge such important duties, and fulfil such serious trusts, is the proper end and aim of all your pursuits whilst here; and surely, the information and discretion necessary for purposes at once so various and complex, cannot be slight or common-place.

From whatever point of view, then, you look at this important subject, the study of which you are about to commence, you find that the motives which prompt you to engage in it, are as imperative as any that could be adduced to stimulate you in any other pursuit that could be named, no matter what its character may be, whether it be intellectual or practical. The nature of the subject invites you to enter upon it; interest points to it, as being indispensably necessary for professional success, and duty prescribes it as the very basis of your professional education: surely, then, it is not too much to expect, that when so many inducements conspire to point out a particular line of action, they will not fail to exert a decided influence on the tenor of your pursuits and conduct whilst here.

During the progress of your studies you are for the most part engaged in considering anatomy in its practical relations to pathology, or the science of disease. You are necessarily aware of the division of the healing art into two compartments, medicine and surgery. A correct knowledge of the structure of the human body is indispensably necessary to a right understanding of either, and it is rather remarkable that the method of study and investigation differs according as it is undertaken, in reference to the one or the other. The principle of analysis guides us in each, but the mode of conducting it varies. Thus, when we examine the structure of internal organs, as a necessary preliminary to an investigation of their functions and diseases, we resolve these parts severally into the elementary textures of which they are composed, and then study the characters, composition,—the physical and vital properties of each texture, separately. After which we consider them in their various combinations in the organs which they collectively make up. This mode of considering organized bodies is not an unnatural abstraction, or a speculative refinement; it arises from the nature of their composition, and is founded on the most approved principles of philosophical investigation. We may exemplify this method of proceeding, by considering the application that has been made of it in the study of diseases of the lungs.

We find these organs invested externally by a serous, and internally lined by a mucous membrane, which pervades the bronchial tubes,

even to their ultimate termination in the air-cells. If we could just imagine the one to be drawn out from the interior, and the other peeled off, like the rind from a fruit, we should leave insulated, what the older anatomists termed the parenchyma of the organ. Now, observation has shown that either of these three component parts may be inflamed separately, the others remaining unaffected; and pathologists have remarked the inflamed condition of these textures by distinct names, the one being called Pleuritis, the other Bronchitis, the third Pneumonia. The serous membrane, when inflamed, will present a certain set of characters, go through a series of changes, and exhibit a train of phenomena in its anatomical characters, as well as in the symptoms which arise, as widely different from those presented by the mucous membrane, under similar circumstances, as if these textures did not belong to the same organ. But, if we examine the progress of inflammation in the peritoneum, in the arachnoid, or in the serous lamella of the pericardium, and compare its characters and symptoms with those presented by the pleura, we shall find the most striking similitude, though these membranes are placed in different cavities, and enter into the composition of organs, which minister to perfectly distinct functions. As, in consequence of their striking similarity in structure, properties, and anatomical characters, these membranes are ranged under one head, and form one class, so their diseases should also form one group; on the obvious principle, that the more close the similitude between parts in their structure, functions, and characters, in health, the more nearly will they resemble one another in the changes induced by disease.

These considerations at once point out the necessity of applying the principle of analysis, aided by experiment and observation, to the study of anatomy; they indicate also a mode of arranging diseases according to a natural method, by grouping them together according to their mutual affinities, and thereby introducing into medicine those rigorous methods of investigation, which have already effected so much for other departments of natural science.

When the structure of the body is investigated, in reference to practical Surgery, a different method is pursued. The body is considered as divisible, not into elementary textures, but into separate

regions, or compartments, each requiring a special degree of attention, inasmuch as it may become the seat of a disease, or the subject of an accident requiring an operation for its cure. Anatomy, studied in this way becomes a sort of topography, as it includes a consideration of the extent and boundaries of each region, the lines and ridges which intersect it, and serve as so many landmarks to guide the steps of those who explore it. But attention is not to be confined to the surface of things, the anatomist dips beneath it, and scrutinises the form, size, and structure, of the different lamellæ that lie layer after layer, one upon another, and fill up the interval between the skin and the solid substratum—the bone. Each part is thus seen in its natural position, and every circumstance is taken into account which can influence the choice of one operation rather than another, as well as the method of executing every step of the operation which is selected. In this department of our course I have hitherto co-operated with my respected friend, Mr. Tyrrell; in the study of it, it has been my good fortune to enjoy the advantage of his advice and precepts, the importance of which I sensibly feel, and the value of which you can fully appreciate. If any thing can add to the value of precepts, founded on long and varied experience, as well as on a minute acquaintance with every thing that relates to the principles and practice of surgery, it is that they are always communicated freely and without reserve, and conveyed in language at once clear and perspicuous. I have always looked to our friendship and acquaintance with unmixed satisfaction; they never for a moment admitted of diminution or interruption, and now, when he confines himself to the department of Surgery, and resigns this of Anatomy to me, I can look forward with confidence to a continuance of the same mutual friendly feeling in public, as well as in private.

Speaking of my senior friend and colleague, I have to allude to him who is junior, Mr. Evans. Our acquaintance commenced in this place, that acquaintance soon ripened into friendship, and that friendship is now cemented by our association as colleagues. It has always been to me a source of pleasure to observe the steadiness of his application in the pursuit of professional knowledge, and advancement in professional reputation. I confidently hope that amongst those

here present on this occasion there are many who will as fully realize the expectations which their friends entertain of them, and that whenever in after-life they shall look back on the time spent amongst us, it will be with the pleasurable recollection of having steadily devoted it to the acquisition of professional, as well as general, attainment.

At your entrance into this place, I feel anxious to impress upon you, as a principle for your guidance, that you are no longer to consider yourselves merely as pupils; you should consider yourselves as professional gentlemen, assembled here as in a place of study, where you are to acquire that knowledge, and those attainments, which are necessary for the discharge of the duties of that profession to which you have devoted yourselves. Knowledge, no matter how extended and various it may be, will not ensure success or conciliate esteem unless it be supported by principle and conduct. You come here to acquire professional knowledge, I trust you will be not only assiduous in that pursuit, but also punctilious in the observance of all the proprieties of professional conduct. As to the relation which is about to spring up between us, I should wish to consider it not as that between master and pupil, so much as that which should exist between senior and junior, assuming both to be guided by strictly professional principles; and, as to rank or station, I, for my own part, ask for none, covet none, am ambitious of none, save that which acquirement and conduct can never fail to vindicate for themselves either here or elsewhere.

LECTURE

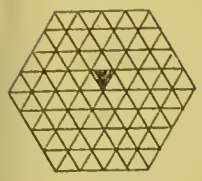
ON THE

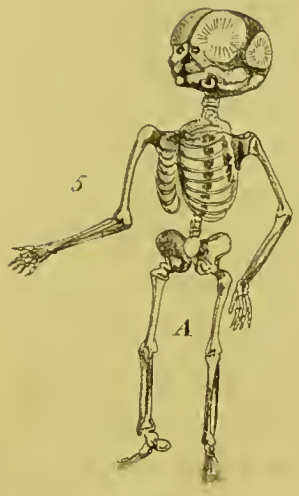
STUDY OF PHYSIOLOGY.

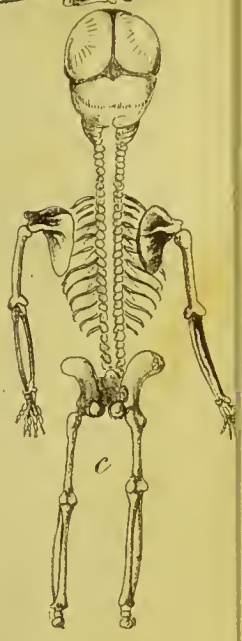
HAVING at our meeting, yesterday, presented to you some general views of the structure of Man and Animals, I shall to-day offer some remarks on the second section of our course, or that which treats of Physiology.

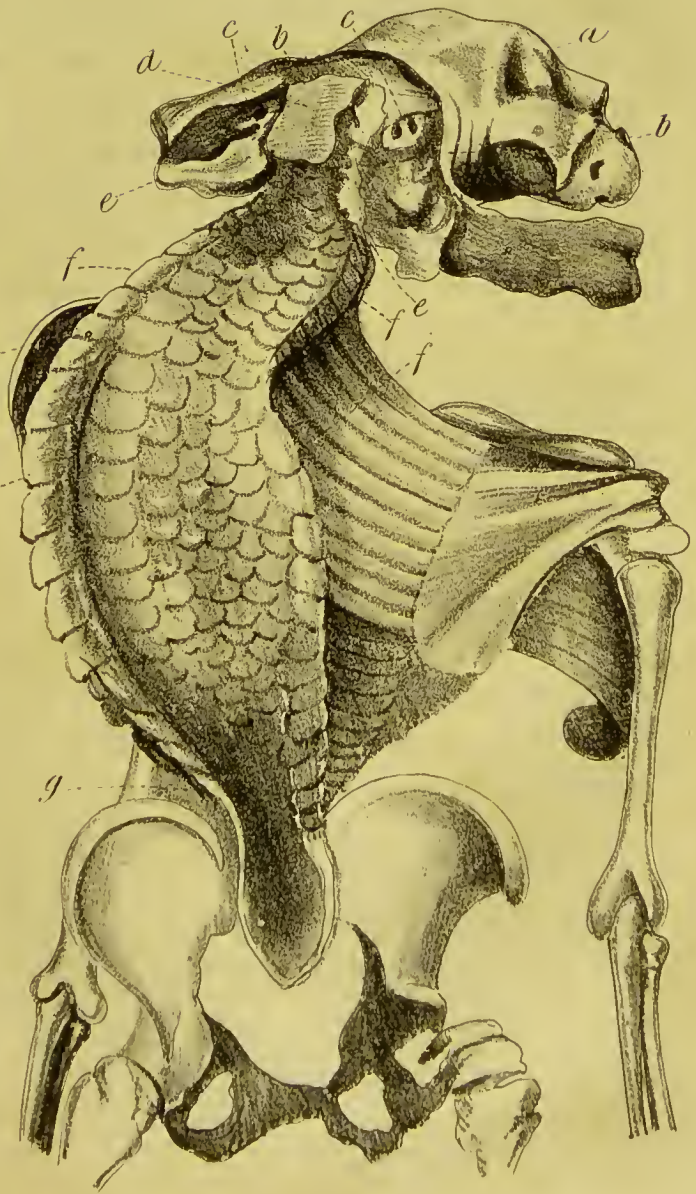
Physiology means literally a discourse on Nature; so that when taken in the original signification of the term, it included within its comprehension the whole range of Natural Science; it is now, however, confined to that department of it, which treats of the various phenomena of living beings; the laws which preside over them, and the agencies by which their existence is, in the first instance, determined, as well as those by which it is subsequently maintained. In short, it is the science of life, in all its various forms, and as such has been called "Biology." You are aware that anatomy is usually divided into two compartments, human and comparative. Physiology is similarly divided. This does not arise from any thing in the nature of the subject; the laws of life, the principles of organization are the same in all animated beings, however modified they may be in the conditions of their existence. The division appears to have been adopted merely as a matter of convenience, for to investigate such a subject thoroughly in all its details and bearings, much less to make efforts towards extending its boundaries, would far exceed the power of ordinary individuals. This defect of our constitution can only be remedied by acting on the principle of the division of labour, as the only means of attaining an adequate degree of precision and minuteness in details so varied and complete. Yet

PLATE 2









this has been attended with one ill consequence that deserves notice. When a man's mind has been constantly directed to a particular pursuit, or department of study, and has been engaged for a considerable time in such investigations as it requires, it evinces a remarkable proneness to make a general application of the principles derived from its favorite study, and to reduce within their limits subjects with which they have no legitimate connexion.

Thus a well known writer who had long made Geology his study, and who, from observing the mode of aggregation in different masses of matter, naturally enough concluded that a mass of rock, or even a mountain, is formed in the same way as a single crystal is, viz. by attraction of particles, extends the operation of the principle a step further, and concludes that Man is also formed by attraction, and, therefore, is little else than a crystal. He fancies, to use his own words, that he has arrived at the knowledge of the great truth to which all geological phenomena lead, namely, "that all the diversities of formation arise only through external movements, modifying the internal powers of attraction, and which, at last, when they have reached their highest pitch of conflict, against each other, give rise to the vivifying power." And further on he adds, "the great course of Nature is one and the same, from the coagulation of granite up to the career of man."

A system of a very different character from this, but founded on equally questionable views, has been advocated by some zoologists of considerable reputation. In the first place, it is taken for granted that Matter when put in motion has a tendency to assume certain forms, and, if subjected to the influence of heat and moisture, will engender some of the more simple animalculæ. In the next place, it is with equal complacency assumed, that these do not remain in their original condition, but possess a tendency to improve in their conformation, and by a successive series of gradations become more and more perfect in their structure, and are evolved into new conditions of existence, passing through all the phases of being, from the mite, or animated dot, up to man. So that, to use the words of these imaginative persons, "the origin of the cedar of Libanus may be deduced from a lichen, that of the elephant from a zoophyte, whilst

man himself, the lord of the creation, may possibly come from a fish or a reptile."

It is a favorite opinion with some that Cosmogonists are generally sceptics. Yet there certainly is nothing in the study of the phenomena of Nature which has a tendency to beget what is called scepticism; quite the contrary is the fact. I believe it would be much more near the truth to say, that sceptics generally become cosmogonists; for if we could follow the progress of opinion in persons who deserve the name of sceptics, and trace it through the steps of its changes, I rather think we should find that these individuals had, in the first instance, acquired a particular bias, and then proceeded to generalise their preconceived notions by making application of them to any other topics that may have to come within the sphere of their inquiries. It must be from some such bias as this, that the Geologist can conceive it possible that the varied phenomena of life may be referred to the laws which govern the particles of inert matter, and that the Zoologist—having surveyed the links of the extended chain which connects the highest with the lowest order of animals, and having noted the steps of the gradation by which they rise, one over the other, in proportion as they are endowed with a more complete organization and a greater extent of power,—hastily comes to the conclusion, that the more perfect animal is but an emanation from, or a descendant of the less perfect, and that it had gone through a progress of improvement and change analogous to that observed in Insects, in which the ovum is evolved into the larva, the larva into the crysalis, and this again into the perfect insect.

The errors of such hypotheses as these, and the sources from which they spring, are readily perceived by placing them together and contrasting them. Each bears the impress of a mind strongly biassed by principles, deduced from a favorite pursuit, and both wander equally beyond the bounds of strict observation and legitimate inference. The geologist overlooks the absurdity he commits when he assumes that matter,—one of whose most obvious properties is inertness,—can impress on itself powers, viz. those of life, which can altogether control the fundamental property by which matter is governed, viz. attraction. And the zoologist, when he founds a system

on the assumption, that at some remote period or other, far back, no doubt, in the dimness of time, there arose from an accidental concurrence of particles of matter a Moss, or a Lichen, which as it mouldered to decay gave origin to a group of Mites, Rotiferæ, or other minute animalculæ, and that these in process of time assumed new forms, ascending in the scale of being, and becoming, from generation to generation, more and more perfect;—the Zoologist, in assuming all this, overlooks the unanswerable objections to such a system that may be deduced from history, which supplies abundant evidence to prove that the form, size, and structure of all the Animals of which we have any knowledge were just as perfect some thousand years ago as they are at this day. And, moreover, that we never have traced or noted any tendency in individuals or in species to ascend in the scale of Animals, or to become more perfect from being less so; and, finally, that the physical and intellectual characters of Man were as fully developed three thousand years ago, (the period at which authentic history begins,) as they are at the present hour.

This theory, which goes on the assumption that the different species of more perfect Animals are derived from the less perfect, was advocated by Lamarck, and gained a great many converts, so much so that Cuvier felt himself called on to combat it with all the powers of his eloquence, and all the resources of his knowledge. Lamarck laid great stress on the influence which time may be supposed to exert in effecting changes in the form and condition of animals; but, what time may produce in the mind of a theorist is one thing, what it has actually produced according to the testimony of history is quite another. If we appeal to history and authentic records on this point, we shall find them decisive of the question. You are aware that the Egyptians were accustomed to confer what may be termed an earthly immortality on their friends, by embalming their remains. The superstition in which they were immersed prompted them to pay a similar tribute of respect to several inferior animals. In their tombs and catacombs, even at the present day, may be found Mummies of dogs, cats, birds of prey, monkeys, and crocodiles, which differ no more from the kindred species now existing in the same country, than the Mummies of the human species differ from the skeletons of men of the

present day. Moreover, the figures of animals sculptured on obelisks, perfectly resemble, in their outline and general character, the corresponding species, such as we now find them. We can form a conception of what a long time may produce, only by multiplying in idea what shorter periods actually have produced; in the instances just cited, we find no evidence of a change either in the conformation or structure of animals, within a period equal to two or three thousand years; we, therefore, have no grounds for admitting the existence of any changes in these particulars, within a period equal to any multiple of this that can be conceived.

Considerable attention has been at different times paid to the natural history of that remarkable bird, the Ibis, to which the ancient Egyptians paid so much veneration. They considered it as a tutelary guardian, commissioned by the gods to watch over their country, and prevent the increase or incursion of noxious reptiles, which, but for its interposition, would have brought desolation on the land. Hence it was reared in their temples, suffered to wander unmolested in their streets; it was honoured whilst living, and embalmed when dead. We appeal to it on the present occasion,—it removes any vestige of doubt that may remain on the mind. The Ibis of the present day is in every respect identical with that which existed in the time of the Pharoahs.*

Hypotheses such as these could impose only on persons biassed by prepossession, or on the inexperienced, who may not be able to detect the errors of fact, as well as of inference, which run through them. As, however, you will frequently meet with such opinions in the writings of persons in other respects deserving consideration, it may serve a useful purpose to make you acquainted with them, and, at the same time, shew you that they are not tenable.

In order to place the subject in a clear point of view before you, and to shew you that a rule cannot be transferred from masses of unorganized matter to organized and animated beings, it becomes necessary to consider the forms and characters which are peculiar to organized bodies, and which fully distinguish them from the

* Cuvier's Essay on the Ibis.

masses of matter that belong to the Mineral Kingdom. When we prosecute this inquiry with the attention it deserves, when we compare the external forms and internal structure, which mark the different groups of objects, included within the boundaries of the three great divisions of nature's wide domain, we shall find them strikingly contrasted in almost every particular.

A mineral production, for instance a crystal, consists of particles of the same kind of matter, united by affinity or elective attraction. Its form is fixed, so is its composition and specific gravity; and it can be increased only by deposits laid on its external surface. Its form depends altogether on the arrangement of its components; consequently, it may be altered by the influence of various circumstances.

Hence arise the great number of different, though still regular, forms presented by crystals of the same substance. For instance, carbonate of lime is found, at one time, in the rhomboid form, at another, as a hexaëdral prism, or of a dodecaëdron.

A crystal presents several sides, [plate 2, fig. 1,] bounded by right lines, meeting so as to form angles of various sizes, and by a little care it may be mechanically divided into layers, parallel with one another, and with some of the lines which bound its surface. The formation of crystals is altogether owing to the deposition of particles of matter, arranged according to the fixed laws which regulate chemical attraction. And, when a crystal is once formed, it is quite impossible that any additional particles of the same sort can insinuate themselves between those of the mass previously existing. In order that they should do so, they must be acted on by a force greater than that connecting the particles of the crystal, which cannot be the case, as the power that acts on all is one and the same, viz. attraction. But, if a substance possessing a stronger attraction for one of the constituents of the crystal than they have for one another, be made to act upon them, they are separated and dissolved, and the crystalline form is lost. We may then consider them as homogeneous bodies in the strictest sense of the word, the specific gravity of their constituent parts being constant and determinate.

When we pass to the examination of organized bodies, we find,

even in their external forms, essential differences between them and minerals. The surfaces of vegetables or animals are never bounded by straight lines, we never find in them the polyhedral form. Vegetables present externally a simple curve, [fig. 2;] animals generally a doubled curve, [fig. 3, 4.] Organized bodies cannot be separated into layers, in the same way as minerals can, for, though they present a lamellated arrangement, still the lamellæ cannot be detached or separated without being torn, or probably without causing the death of the body to which they belong. Still water, or any other fluid, may be introduced into the meshes of their reticulated texture, without producing any alteration in their form, or inducing any other change, except an increase of weight and size. From this it appears that the parts of organized structures are held together by a force not only superior to that of attraction, but altogether different from it.

The composition of organized bodies is not homogeneous throughout their entire extent, like that of minerals; on the contrary, it differs very considerably in different parts. Thus, phosphate of lime, the chief constituent of bone, could never be mistaken for fibrine, which is the basis of the muscular structure. And, even when the integrant particles are identical, their arrangement and mode of distribution may vary considerably. Thus the long and hard bones differ very much in texture from those that are soft and spongy; the muscles of animal life can be easily distinguished from those of organic life. If these obvious facts be considered attentively, we must at once see that such marked differences could not exist if the integrant particles of animal structures were governed merely by the laws of attraction.

I have already stated the mode in which unorganized bodies, such as crystals, are formed, commencing with a central nucleus [fig. 1;] they are enlarged by the deposition of layers on its surfaces. Hence, as the increase thus proceeds from the centre of the circumference, it may be termed concentric. Organized bodies, I should say those of the animal kingdom, grow and increase by a process the reverse of this. The developement of each part taken singly, and of the whole body taken in its aggregate, begins at the circumference, and thence proceeds towards the centre, so that the outline of each part and of the

whole is first sketched, and then their completion is effected by successive depositions, taking place from circumference to centre; hence the process of growth is really eccentric, or the very reverse of what would happen, were their components aggregated by attraction. This result is the fruit of modern research, it has been deduced from an extended and cautious inquiry, and established by a full and complete induction. In the early periods of fœtal existence, as soon as the different textures are distinguishable, each organ and part of the body is in the first instance double, its parts being placed laterally with regard to one another; but, as the process of nutrition goes on, they gradually approach and unite, so as to form organs usually termed single, from the circumstance of their having been examined only after their growth has been completed. The process of ossification, for instance, proceeds from the circumference towards the centre. Thus the lateral parts of the cranial bones are formed first, [fig. 5, 6, 7.] And their extension proceeds from the sides, beginning at the prominent points of the parietal and frontal bones, and thence extends to the central line. Each vertebra of the spinal column, and therefore the whole pillar itself, even including the sacrum, is open along its entire length, [fig. 7,] and appears as if composed of two parts, which finally become soldered together along the median line. The principle of eccentric developement obtains in the muscular system also, the lateral parts being produced before those at the middle line of the body. On the head, the temporal, masseter, and pterygoïd muscles, are the first that can be recognized; the zigomatici, the buccinator, and orbiculares, come next in order; and lastly, those of the nose. On the thorax, the intercostals precede the muscles situated in the costo-spinal fossæ, as well as those attached to the sternum; and in the abdominal region, the obliqui are formed in the first instance, the recti and pyramidales, situated along the middle line, subsequently. The abdomen, in fact, in the early periods of fœtal life, presents an open cavity, the viscera being quite uncovered, [fig. 8,] but in proportion as the muscles extend inwards from the sides to the central line, the opening becomes gradually diminished, and the organs enclosed, so that at birth no interval remains, except that which transmits the umbilical vessels.

The nervous system, in its developement, obeys the same law; the nerves on the sides of the head, trunk, and pelvis, are formed independently of the brain and spinal marrow, and their cords and filaments may be distinctly traced, so that the nerves may be said to begin where they have been hitherto thought to terminate, and vice versâ. The spinal chord, when just distinguishable, consist of two lamellæ, or bands, separated by a slight interval; these soon unite in front, so as to form a groove, and finally at the opposite point, constituting a cylindrical tube, which is gradually filled up by a series of lamellæ deposited one within the other, until it is converted into a solid mass of a cylindrical form. The lateral masses of the brain when first deposited are quite distinct from one another, but, as the process of growth extends towards the median line, the corpus callosum, and the other commissures, are produced, which establish a connexion between them, and when the union is completed, its line of direction is indicated by the raphé, preceptible along the upper surface of the corpus callosum, and which is found to extend quite through its substance.*

A knowledge of these laws has thrown considerable light on one of the most obscure subjects connected with the animal economy, viz. the occasional formation of those bizarre productions called Monsters. They have been regarded hitherto as "lusus naturæ," as if they had been formed by a total subversion of nature's laws, and admitted of no explanation on rational principles.

In ancient times, when man was believed to be influenced and controlled by invisible spirits, Monsters were supposed to be produced by supernatural agency. Whenever a deformed infant was born, even in the most civilized places, such as Rome or Athens, the inhabitants of these cities, so justly proud of their intellectual superiority, assembled in their temples to endeavour to appease the anger of the gods. But, though in process of time, reason got the better of these superstitious notions, it only shook off one error to light on another. At no very remote period the birth of a monster was looked on as a public calamity—a presage of a war, or a famine; and, even more near to our own times, these deformities were considered as altogether beyond the reach of our scrutiny. A conviction such as

* Elements of Anatomy, p. 23, 25.

this could not long have retained its influence. The active spirit of man will always prefer an hypothesis, however gratuitous, to total inaction. Accordingly we find that several attempts have been made to explain such productions.

During those times in which hypothesis took precedence of inquiry, and speculation served as a substitute for research, it would be vain to expect that the opinions entertained on such subjects could be otherwise than wild and visionary; but, when reason resumed her seat, the visionary and the speculative were relegated to the illiterate, amongst whom they still hold dominion; for the prejudices of the vulgar, in too many instances, are but the cast clothes of philosophers. It is now, however, clearly ascertained by researches, conducted in the true spirit of philosophic inquiry, that the different anomalies of form and structure, which from time to time occur in the human fœtus, are determined by a partial suspension or derangement of the process of developement, by which certain parts are left more or less incomplete, and stinted of their natural proportions. This of course occurs most usually along the median line, and in one case will amount to no more than a hare-lip, [fig. 8, a,] or a fissured palate, which are owing to a want of union between their lateral parts. The various forms of hermaphrodism are attributable to a want of union in the pubic and perineal regions, or rather to a derangement in the developement of the generative system; and if the walls of the abdomen be incomplete, from the same cause, the viscera may remain more or less uncovered, [fig. 8.] In acephalous cases, from the like cause, the spinal chord and brain may be totally wanting; or, whilst the former attains its natural proportions, the latter may remain incomplete to a greater or less extent. Whatever be the degree of deficiency in the cerebro-spinal organs, it is in all cases accompanied by a corresponding defect in the osseous cavity in which it is lodged. In some cases the cranial bones remain as mere rudiments, and the vertebral canal is open in its entire extent; in others the latter is closed, the imperfection being confined to the cranium and brain.

The skeleton before you, the appearance of which is correctly expressed in the drawing, [fig. 9,] exhibits some of these deviations

very strikingly. The skull is altogether open at the vertex, the parietal bones [*b*, *b*,] are mere rudiments and somewhat everted, the frontal bone [*a*,] is depressed, forming a flat surface, the occipital bone presents its basilar part nearly perfect, but unconnected with the lateral masses, which are depressed and turned outwards. The spinal column is open in its entire length, the arches of the vertebræ [*f*, *f*,] are more than an inch apart, and curve outwards to the ribs, except at the lower part of the lumbar region, and in the sacrum, where they take their natural direction, but are still very far asunder, and form a deep groove.

These facts are important in many points of view. The law or general principle deduced from them, viz. that the developement of animal bodies proceed from circumference to centre, or eccentrically, is decisive with regard to some of the most difficult questions concerning organization and life.

I call your attention to these facts, and to the inferences which flow from them; I dwell on them thus fully, not merely because they are interesting, in the highest degree, but because they throw considerable light, and, in my humble judgment, determine the great question so long at issue between the two chief sects of physiologists, the Vitalists and the Materialists. And so far as I know, this special application (and it is a very important one,) of the facts and principles derived from researches into the growth and developement of organized structures has not hitherto been made. We may contrast the characters of organized structures with those of unorganized bodies, we find no great difficulty in indicating in general terms the distinction between them. When we compare their external forms and internal arrangement and structure, we find the differences still more strongly marked; but still we are not able to draw a conclusive line of demarkation until we investigate the process of growth and increase in each. The particles which enter into the composition of our frame, so far from being disposed or arranged according to the laws of attraction, obey a rule the very reverse of this, as we have already seen; and moreover the eccentric developement is found to obtain even on those structures which, in external appearance and character, more nearly resemble unorganized matter than any other parts of the living

fabric, for instance, in the teeth, and in the tusks of animals; if even, in such structures, the process of growth here indicated obtains,—if during their growth the influence of attraction is suspended, and even contravened, it furnishes an argument, "a fortiori," against the probability of its obtaining in those other parts of the system which differ so obviously—so essentially, from every form of inert matter. Within the jaw, during early infancy, we find a series of small membranous sacs, the precursors of the future teeth. They receive small branches from the dental vessels. I need not enter further into details just now, suffice it to say, that at the bottom of the sacculus (adopting that term as a means of distinguishing the internal membrane, or shut sac, from the external one which is reflected over it,) a soft, vascular mass arises, supplied with vessels and nerves, derived from those ramified on the sacculus. This mass gradually increases, and assumes the form of the tooth, and constitutes, as it were, the model on which it is to be moulded. The osseous matter begins to be deposited first on its free surface, in a thin lamella, corresponding with the crown of the tooth; or rather in dots or scales, corresponding with each of the inequalities on its upper surface, and gradually uniting to form a lamella. When the breadth is completed, the growth in length begins, and extends from the crown to the roots, by successive depositions on the exterior of the pulp; so that it may be said to clothe itself in osseous matter, the roots being the parts last formed, the crown first. The bony lamella is at first remarkably thin, and the contained cavity of considerable size; but, as the former increases in thickness, by successive depositions on its inner surface, the latter and its enclosed pulp become proportionally diminished, until the roots and body of the tooth have acquired their proper degree of thickness. [Plate 2, fig. 10. *o. p. q. r. s.*]

Unorganized bodies once formed remain fixed and unchanged, neither admitting of movement amongst their parts, or allowing the insinuation between them of substances of the same or of a different kind. Organized bodies consist of solid and fluid parts, and, so long as life last, the fluids are subjected to a constant movement; but, movement is not confined to the fluids; the solids are likewise subjected to a ceaseless internal change, in which we can trace evidences

of a separation of old particles, and a corresponding deposition of new ones in their stead. Here are three small skeletons of different sizes, A, B, C, [fig. 5. 6. 7.] let us suppose them to represent different ages of the same individual. The particles of which A is composed, are removed and replaced by others, by the time the individual has attained the age of B, and the components of B are in their turn supplanted by those which make it up when it reaches the condition of C. Now, if body be merely a compound, made up of particles in constant flux, how can such an aggregate possess a consciousness of personal identity? Those who advocate this hypothesis, doubtless conceive that the particles A, as they leave their position, transfer their consciousness to B, and B again to C; so that this individual, when he casts a retrospect over his past life, and surveys the continuity of his own existence, (imagining himself to be one and the same sentient and thinking being,) at the second stage, is B, so far as his composition is concerned, but in feeling, idea, and consciousness is A; and in the third stage, though really C, he still is not C, but A; or in other words, he is not himself, but a different person; or he is different, yet the same, at the same moment of time. This dilemma cannot be evaded by any one who contends that nothing exists but matter and motion, and that all the phenomena which we witness "arise through external movements, modifying the internal powers of attraction."

The personal I is confessed a permanently being; every individual acts as if he were one and identical; and such he is invariably considered by others, notwithstanding the admitted fact, that the material components of his body are subject to a perpetual mutation; for, over this ceaseless cycle of change presides that power, which altogether suspends the ordinary play of affinities in the first moments of fœtal existence, modifies and controls them during the succeeding stages of life, and allows them to come into action, only when it is withdrawn at death. "I had rather," says Bacon, "believe all the fables of the Legend, the Talmud, and the Koran, than that this universal frame is without a mind. When the mind of man looketh to second causes scattered, it may sometimes rest on them, and go no farther; but when it beholdeth the chain of them confederate and

linked together, it must needs flee to Providence and to Deity." How strangely then do those men argue, who contend that all the phenomena of living beings, and all the functions which they perform, are results—the necessary results of their organization; and that their structure is produced by an aggregation of particles, according to the laws of chemical attraction. We have seen, however, that such is not the rule of their formation; so far from it, they are formed by a process the very reverse of this; which is a conclusive evidence that there is some other power at work, besides that of attraction. But, were we, for a moment, to admit that the form and structure of organized bodies are determined by attraction, then we could have no grounds for expecting to find evidence of design or forethought in their conformation. This at once prompts us to enquire, (and surely it is an interesting subject of enquiry) whether they do not exhibit incontestable evidences of both, in whatever point of view we examine their habits and capabilities, or investigate their structure.

It is a favorite opinion with many that all our knowledge is derived from the senses; as well might it be said that all arts and manufactures are derived from the doors and windows of the houses, into which the raw materials are brought to be subjected to the skill and dexterity of the workmen. Again, as our senses exist before we have acquired any experience, we have sufficient grounds for questioning another assertion, which is frequently put forth, namely, that all knowledge comes from experience. There is a sort of knowledge which is prior to experience, and acts quicker than reason, and which exhibits itself for the most part in prompting measures for self preservation. Thus young animals seek the breast from which their nutriment is derived; and, in after-life, the different tribes of living beings select different sorts of substances for their food: some feed on herbs, and every part of their conformation marks them to be fitted and intended for digesting that kind of food. Others live on animal substances, and as we saw yesterday, when examining the structure of carnivorous animals, the conformation of their teeth, jaws, stomach, limbs, adapt them for the habits that have been impressed on them. Some become torpid during winter, and choose places of security whilst in that state; others, as the swallow, enjoy a perpetual summer, by migrating from one country

to another, and their conformation enables them to fulfil their destination. The bee and the wasp lay up stores for winter, and, strange to say, the comb which the bee builds is always placed vertically, that of the wasp, horizontally. Moreover, the cells are all constructed on strictly geometrical principles; for each of them is a hexagon, terminated by a pyramidal base. In the execution of their work they give a practieal solution of a very difficult problem: "A quantity of wax being given to form out of it, similar and eqnal cells of a determinate capacity, but at the same time so arranged, collectively, as to occupy the smallest possible space, whilst each individual cell possesses the largest possible area in proportion to the quantity of matter employed." If they were cylindrical, vacant spaces must exist between each three contignous cells; if they were square or triangular, they would require more material and be altogether unsuited to the form of the bee's body.

Is it from instruction—is it from their senses—is it from experience, that these creatures execute their work with the precision and method of the most accomplished artists? No one, I believe, would answer in the affirmative; each group of living things has its special aptitudes, its peculiar habits.

> Dente lupus, cornu taurus petit; unde nisi intus
> Monstratum?

Their habits and their aptitudes are stamped upon them at the first moment of their being, and constitute them so many agents fashioned for the execution of a purpose,—so many means devised for the attainment of an end; as such, every one of them bears upon it the impress of design and contrivance. Observe some of these groups attentively, note the peculiarities which characterise them, and then pass on to an investigation of their internal structure and conformation, you will not fail to find abundant evidence of their perfect adaptation to their different spheres of action—their various modes of life.

Some animals live and move in water, some on the earth, others in the air, and these are the especial conditions of their existence. The skeleton of fishes has less earthy matter than that of land animals,

some being altogether cartilaginous, which renders them flexible and elastic, and at the same time light and buoyant. In that of birds there is a special provision, by which firmness and lightness are at once secured. Their long bones form hollow cylinders, filled with air, conveyed into them from the respiratory passages, the purpose of which is sufficiently obvious. The shell of the bone is particularly close and compact in its structure, and as the diameter of the shaft is increased by its forming a hollow cylinder, a double provision is established for strength and firmness. A very different conformation obtains in some slow-moving animals, such as the land Tortoise, their bones being heavy and solid, so much so that they do not contain even a medullary cavity. The Eye, in birds, is secured from the efforts of their rapid passage through the air, and from exposure to intense light in high regions of the atmosphere, by a curious provision. There is a membrane, which, at the will of the animal, can be drawn like a film over the eye-ball. It is thin, translucent, and elastic as Indian rubber, so that it retracts of itself as soon as the muscular effort ceases, which draws it over the eye, and retreats to the inner angle, where it is altogether removed from the field of vision.

The Head in man rests on the summit of the spine, where it is supported like the capital on the top of a column, and so nearly equipoised, that but little muscular effort is required to keep the line of its base horizontal, and that of the face vertical, which is its natural position. In quadrupeds the spine being horizontal, the head is appended to its anterior extremity, and therefore would require a considerable effort to sustain it, which would be tiresome, if not painful, to the animal. To avoid this, a peculiar provision is given them, for the head is supported by an elastic band, stretched between the occiput, and the spines of the vertebræ; so that the weight is sustained by a special contrivance, without any effort of the animal, or any exercise of the will.

The movements of the Head on the Spine, are, as you are conscious, various and complex, much more so than any human contrivance could admit of, even than the universal joint invented by Mr. Hook. It admits of flexion, extension, rotation, sliding, and all the modifications of these. Nothing can be conceived more perfect than

the adjustment of the moving surfaces to one another, or the completeness, and at the same time simplicity, of the provisions to retain them in their proper position by checks and ligaments. The surfaces present an exquisite smoothness and polish, yet are not injured by friction; they are delicate to a degree, yet require no provision against attrition, I mean human provision, and any that could be devised would be injurious. Still, delicate as these surfaces are, they endure for half a century or more, and are kept in perfect repair by their own inherent powers. Yet there are persons who would contend that all this is effected by masses of matter, formed by attraction; there are some who would deny that such a structure as this is the result of design or intelligence! who assert that the form and adaptation of these different bony substances is determined by the aggregation of particles acted on by mere attraction! Will attraction also account for the form of the ligaments which bind them,—of the muscles which move them,—of the vessels which supply the materials of growth, and the nerves that impart their special susceptibilities of impression? But suppose that attraction did determine, in the first instance, the arrangement of the particles of which the living body is composed, can we conceive that it is the same attraction which determines the removal of old or effete parts, during the process of growth or reparation, as well as all the other changes that are ceaselessly going on in the system? During the process of growth some particles are being continually taken up, say from this bone, and others laid down in their place. Now, those that remain,—those removed,—and those deposited in their stead, all consist of phosphate of lime. If such changes as these necessarily followed from the operation of the ordinary laws of matter, we should be constrained to admit that particles of the same identical substance, in the same place, and in exactly the same circumstances, can, at the same moment of time, be mutually attracted and repelled, and that this state of things could exist during life without producing either confusion or derangement.

I shall now direct your attention to one topic more; I select it, because it forms an era in the annals of medicine, and is connected with the history of a man whose name has shed a lustre on the pro-

fession to which he belonged, and the country which gave him birth. I allude to the doctrine of the circulation of the blood, as taught by Harvey. I call your attention to it in consequence of the evidence of design and contrivance which the circulating system presents, and also because it was a consideration of such evidences that led Harvey to that discovery which has immortalized his name. We all now know that the blood flows from the heart in one set of vessels, and returns to it by another, so as in its course to describe a circle. Yet, how is it proved that it flows continuously, and does not oscillate to and fro? that it flows in a particular direction, and not in another, or in the opposite one? The proofs are of two sorts, the first founded on direct experiment, the second on a consideration of the uses, purposes, or final causes, of certain arrangements in the heart and circulating vessels. If a ligature be placed on the artery of the arm at the elbow, the vessel becomes empty below the ligature, for the supply from the heart is cut off; but, if the ligature be tied round the vein, the vessel swells and fills below it, because the return of the stream to the heart is prevented. This establishes the fact that the blood flows from the heart in the arteries, and to the heart in the veins. Again, by examining the interior of the heart, and of vessels, we discover the second series of proofs, for we find, within the veins, a number of valves or flood-gates, all inclined one way, and so disposed as to allow the current to pass freely towards the heart, and at the same time form so many barriers to its reflux. In the cavities of the heart, also, similar valves or flood-gates are placed, so as to permit the blood to pass in a particular direction, and prevent its regurgitation; and when the stream flows from the heart into the large artery, its return is opposed by a similar contrivance. We can thus trace the current through the different stages of its course; from vein to recipient [auricle], from recipient to propellent [ventricle], from propellent to artery, which transfers the residue of the blood to the vein again; and so the circle is completed. Each link of the chain has its peculiarities; each part exhibits a special adaptation; and the whole the very impress of design and contrivance.

In the study of Physiology this must always be kept in view; but it requires no effort to do so, as the adaptation of means to end,

of structure to function, forces itself on our notice at every step of our progress.

You will doubtless inquire what are the subjects comprised within the limits of Physiology or Biology, as it is now studied? A course of lectures on Human Physiology includes a consideration of all the functions and powers exhibited by the human body, in its natural or healthy condition; these functions are divisible into two classes, viz. those intended for the support and well-being of the individual, and those for the continuance of the species.

These different topics necessarily involve a great variety of facts and of inferences: it was partly in reference to them that I yesterday remarked, that if your studies be not conducted with method, your minds would become oppressed by a load of detail, and would be repelled from the pursuit by its complexity, instead of feeling an interest awakened of the nature of the enquiries which it every moment suggests.

What, then, is the proper method of study? The objects of study, from their very nature, must present themselves in different points of view, and require different methods of investigation. Thus you may consider the situation, form, and size, of a given organ—and then its relations to contiguous parts. When you have

stated all the facts relative to these points, you have given a description of the part, inasmuch as you have followed the *descriptive method* of investigation; and this is all that is usually done in works on Descriptive Anatomy,—they give merely the topography of parts. It must be obvious that it is not sufficient for our purposes thus to confine attention to the surface of things: our inquiries are not to be limited to external qualities, or mere relations of place. We desire to become acquainted with the composition and structure of the human frame, or, in other words, with the elements of which it is made up. With this view, we resolve it into its constituents, and then examine the character and properties of each of these separately, as a necessary preliminary to a just appreciation of their powers when combined. This is the *method by analysis*. Its application and use were indicated yesterday, when treating of what is termed General Anatomy, but which ought rather to be called Analytical or Structural Anatomy.

As the phenomena included in a particular function, or in the derangement of it, do not present themselves to us at once, but occur in succession, it becomes necessary not merely to enumerate them, but to set them down in the exact order of their occurrence. When treating of the digestive function, for instance, we have to consider the mechanism employed in the prehension and mastication of food,—its impregnation with saliva,—its deglutition and conveyance to the stomach,—the changes which the mass undergoes in that viscus, and afterwards successively as it passes step by step through the different parts of the alimentary canal. When these particulars are fully stated, the narrative is complete, and we have conformed to what is termed the *Historical Method*.

We cannot, however, confine ourselves to a mere statement of facts, or an enumeration of events. The very constitution of our minds compels us to make inferences from the facts we have observed: we cannot help thinking,—and to think is to theorise. This we at once recognise as the starting-place of all the speculative views, and all the visionary opinions which the history of medicine records; and, unhappily, they are but too numerous; some of them evidently flow from the disposition so constantly manifested to

deduce general principles from inadequate data; others are referrible to that proneness which persons evince when entering on speculations concerning the phenomena of life, and the functions of living beings to carry with them, and even rigorously apply, notions and principles taken from such pursuits as had previously, and perhaps exclusively engaged their attention. Hence it is that the Philosophers of old introduced into medicine their peculiar hypotheses; the Heathen priests tinctured it with their superstitious rites, whilst, in more modern times, the Mechanists sought to explain the functions of the body in health, and its derangement in disease, by principles deduced from hydraulics, and the Chemists referred them to the affinities which govern the processes they were wont to observe in their laboratories.

"From whence," said Bacon, when discoursing of the speculative systems which obtained in another department of science, "from whence can arise such vagueness and sterility in all the physical systems which have hitherto existed in the world? It is not certainly from any thing in Nature itself; for the steadiness and regularity of the laws by which it is governed, clearly mark them out as objects of certain and precise knowledge; neither can it arise from any want of ability in those who have pursued such inquiries, many of them have been men of the highest talent and genius of the ages in which they lived, and it can therefore arise from nothing else than the perverseness and insufficiency of the methods that have been pursued. Men have sought to make a world from their own conceptions, and to draw from their own minds all the materials they employed; but if, instead of doing so, they had consulted experience and observation, they would have had facts, not opinions, to reason about, and might have ultimately arrived at a knowledge of the laws which govern the material world. As things are conducted at present, a sudden transition is made from sensible objects and particular facts, to general propositions, which are accounted principles, round which, as round so many fixed poles, disputation and argument continually revolve. From propositions thus hastily assumed, all things are derived by a process compendious and precipitate, ill-suited to discovery, but

wonderfully accommodated to debate." The way that promises success is the reverse of this. IT REQUIRES THAT WE SHOULD GENERALIZE SLOWLY, GOING FROM PARTICULAR THINGS TO THOSE WHICH ARE BUT ONE STEP MORE GENERAL, AND FROM THESE TO OTHERS OF STILL GREATER EXTENT, AND SO ON TO SUCH AS ARE UNIVERSAL. By such means we may hope to arrive at principles not vague and obscure, but luminous and well-defined, such as Nature herself will not refuse to acknowledge."

This is the *Inductive Method*, as taught by Bacon, and practised by Newton. To observe patiently, experiment cautiously, and generalize slowly, are the precepts it enjoins for the guidance of our own researches, and the tests which it suggests for estimating the value of the opinions and researches of others. The bias of prepossession, —the influence of authority, has but too long led away the mind from a conformity with its precepts;—these disturbing causes have now nearly passed away, for in our schools no general theory is taught,—no uncompromising dogma is inculcated,—no individual stands so pre-eminent in station as to draw after him a crowd of followers ready to take his dictum as law, and resolved when they set forward in life, to make their practice square with his injunctions; —in a word, there no longer exists a monarchy in medicine, and, were we to look back to the history of those times in which the men of that profession were little else than the obsequious followers of a few distinguished individuals, we should find little reason to regret that their dynasty is at an end. And let not this excite surprise or regret,—it should rather be a ground of satisfaction and gratulation, inasmuch as it has arisen, not from any causes tending to depress the few, but from the wide spread of knowledge, which has tended to elevate the many.

There never was a period in the history of Medicine in which there was less to discourage inquiry than at the present; there never was a time in which so many circumstances conspired to invite a scrutiny into every department of Physiology. The Mind is no longer prostrated by the domination of authority, nor is Reason warped by the influence of system. The errors of our predecessors are so many beacons to warn us from straying into the devious tracks into which

they have wandered, and the failure of their methods of investigation points to the necessity of pursuing a different line of research from that which they adopted. Speculation and Hypothesis have reigned too long; it has been too much the practice of Physiologists to construct systems "from their own conceptions, and to draw from their own minds all the materials they employed." Whilst notoriety (perhaps even distinction) could be attained by such compendious methods, we cannot feel surprise at the number of hypotheses which the history of Medicine records, or at the fleeting credit they maintained. One heresy gave way to another, and a third succeeded as short lived as either of its predecessors.

Truditur dies die
Novæque pergunt interire lunæ.

But, even at the present day, it is not a little difficult to repress speculation altogether, and to confine inquiry within its legitimate bounds: we must then bear with indulgence the observations of persons who lived in less enlightened times.

During the progress of this Course of Lectures I shall have to notice the various opinions which have, from time to time, obtained credence on Physiological subjects, and the grounds of them; but my principal object shall be to fix in your minds those facts which may be considered as established, and the opinions which are now adopted by the best informed persons. The labour of study will be thus abridged; and your attention will be directed to proper objects of pursuit, and to the best methods of prosecuting your inquiries still further, so that after removing to your various destinations in life, you may be enabled to resume the subject, and investigate it for yourselves, in the hope of discovering new facts, and extending the boundaries of knowledge. If that, however, does not accord with the nature of your vocations, you can, with a moderate degree of attention to what is passing in the republic of letters, keep pace with the progress of such improvements as may from time to time take place in Physiological Science.

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